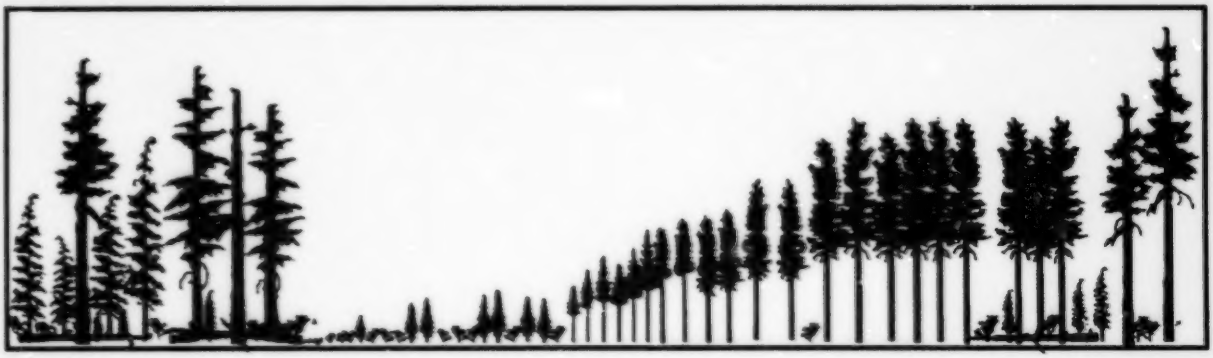
SILVICULTURE

Towards a Silviculture Strategy

A Discussion Paper on Growing and Managing British Columbia's Future Wood Supply

July 1990



Province of
British Columbia
Ministry
of Forests

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July 1990

Silviculture Branch
British Columbia Forest Service

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1.0 Introduction

This discussion paper deals with the need to develop strategic goals for growing and managing British Columbia's future wood supply. It focuses on:

- the strategic planning required for effectively implementing forest management programs in the province;
- the factors involved in developing forest-level goals; and,
- the planning processes and tools required to develop the forest-level goals.

This paper acknowledges the importance of integrated resource management in the forests of B.C. All resources will be considered in developing a provincial silviculture strategy.

Comments are invited from timber supply area committees, tree farm license holders and other interested parties. Please submit your comments by Tuesday, November 30, 1990, to:

The Director
Silviculture Branch
B.C. Forest Service
31 Bastion Square
Victoria, B.C.

1.1 Background

The British Columbia Forest Service's silviculture program must define clearly focused goals and provide the rationale for its activities.

The Forest Service is, at present, involved in several initiatives to produce well-defined strategies for the silvicultural management of our forests.

These initiatives include:

- this discussion paper;
- a technical review of the benefits of incremental silviculture;
- developing and refining growth-and-yield information; and,
- investigating procedures for using financial analysis in operational decision-making.

1.2 Challenge

This discussion paper challenges forest managers and silviculturists to:

- carefully consider how our forests are to be managed today to provide wood supply and other resources in the future; and,
- focus on, and promote, a discussion on strategic planning at the forest estate level and the provincial silviculture program level.

This discussion should focus on the following questions:

- Are we managing silvicultural activities in the province effectively and efficiently?
- Are we meeting each forest estate's management goals through our silvicultural efforts?
- Does each forest estate have defined future fibre-supply goals?

Timber supply area committees and tree farm licence holders should address these questions regarding their forest estates. Silvicultural management strategies are needed for each forest estate so that fibre supply targets and management goals can be defined.

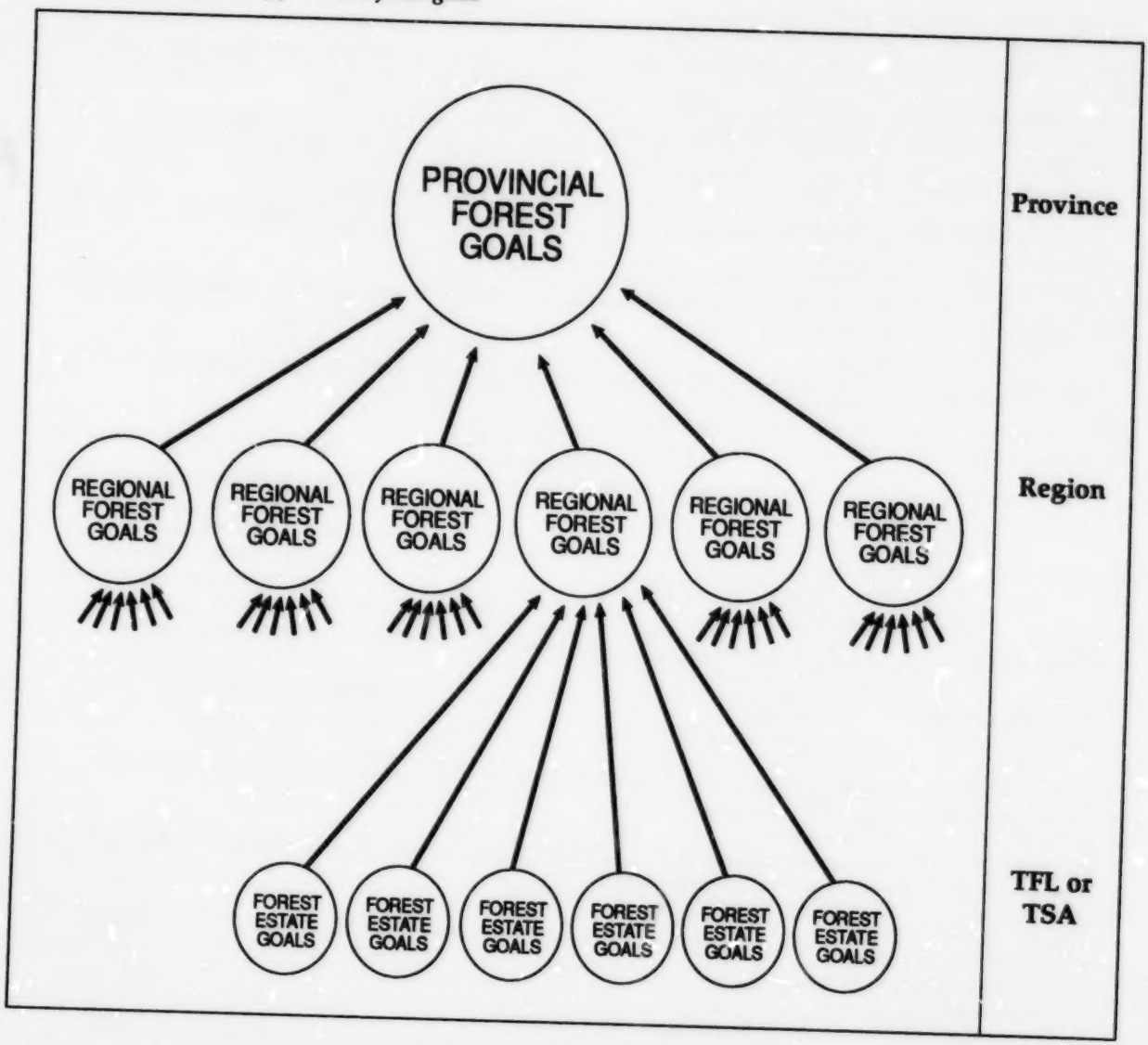
We can then:

- establish regional and provincial goals based on the sum of the forest estates' fibre-supply targets and management goals; and,
- develop effective, operational procedures to produce the target forests.

To establish provincial goals, we must consider many factors. For instance, should our overriding strategy be:

- to ensure that every productive hectare is growing fibre at its optimum growth rate? or,
- to meet a desired fibre flow at least cost? or,
- to ensure that range, wildlife, recreation, fisheries, water quality and other values are maintained and maximized? or,
- a combination of all the above.

Figure 1: Development of provincial forest goals



2.0 Strategic goal

A provincial goal to double the provincial maximum mean annual increment (MAI) by the year 2020 has been proposed.

This goal will move the maximum MAI from 2.5 cubic metres/hectare/year to 5.0 cubic metres/hectare/year.

The following tables summarize the maximum mean annual increment for each timber supply area and tree farm licence. It is based on the current, approved, long-run sustained yield (LRSY) and net operable land base.

The goal is to double the maximum MAI of each management unit.

Table 1: Timber Supply Area (TSA) Summary — Indicated Maximum Mean Annual Increments

Region	TSA	LRSY (m^3/year)	Operable area (hectares)	LRSY indicated MAI (m^3/ha/yr)
Cariboo	Hundred Mile	1 329 700	768 100	1.7
	Quesnel	2 543 600	1 161 300	2.2
	Williams Lake	2 483 400	1 682 200	1.5
Kamloops	Kamloops	2 191 800	1 113 800	2.0
	Lillooet	455 300	308 000	1.5
	Merritt	912 700	614 100	1.5
	Okanagan	1 612 400	1 115 900	1.4
Nelson	Arrow	592 850	268 300	2.2
	Boundary	669 900	328 700	2.0
	Cranbrook	906 275	467 200	1.9
	Golden	432 715	174 400	2.5
	Invermere	627 870	296 500	2.1
	Kootenay Lake	765 650	332 900	2.3
	Revelstoke	102 245	39 200	2.6
Prince George	Dawson Creek	1 310 000	722 200	1.8
	Fort Nelson	959 000	606 700	1.6
	Fort St. John	1 850 000	1 043 200	1.8
	Mackenzie	2 560 300	1 439 900	1.8
	Prince George	7 896 000	3 314 400	2.4
	Robson Valley	451 100	201 200	2.2
Prince Rupert	Bulkley	503 500	291 400	1.7
	Cassiar	143 140	103 200	1.4
	Kalum	417 700	114 400	3.7
	Kispiox	818 600	340 600	2.4
	Lakes	1 306 000	612 770	2.1
	Morice	1 497 600	655 100	2.3
	North Coast	370 200	106 200	3.5
Vancouver	Arrowsmith	407 400	90 816	4.5
	Fraser	1 568 900	387 640	4.0
	Kingcome	1 456 585	354 300	4.1
	Midcoast	871 700	246 300	3.5
	Queen Charlotte	251 200	57 900	4.3
	Soo	510 300	171 600	3.0
	Strathcona	1 194 900	265 903	4.5
	Sunshine Coast	1 154 000	244 962	4.7

Weighted average maximum MAI = 2.2 cubic metres per year.

Table 2: Tree Farm License (TFL) Summary — Indicated Maximum Mean Annual Increments

TFL Number	LRSY (m^3/year)	Operable Area (hectares)	LRSY Indicated MAI
1	625 000	234 649	2.7
3	90 000	52 891	1.7
5	93 900	33 243	2.8
6	1 033 700	143 822	7.2
8	121 000	72 057	1.7
10	219 000	61 820	3.5
13	42 800	22 146	1.9
14	115 800	53 635	2.2
15	61 000	44 458	1.4
18	181 800	67 443	2.7
19	922 000	113 147	8.2
23	585 500	522 748	1.1
24	*	*	*
25	*	*	*
26	41 800	6 952	6.0
30	420 900	158 931	2.6
33	23 800	7 769	3.1
35	88 000	37 397	2.4
37	895 400	134 561	6.7
38	263 000	62 822	4.2
39	3 079 000	537 952	5.7
41	356 100	271 137	1.3
42	92 000	34 619	2.7
43	50 000	5 793	8.6
44	2 630 000	376 048	7.0
45	*	*	*
46	*	*	*
47	*	*	*
48	326 000	468 561	0.7
49	*	*	*
51	127 000	52 902	2.4
53	182 800	79 620	2.3

*Information not available

Weighted average maximum MAI = 2.9 cubic metres per year

3.0 Planning framework

In developing a silviculture management strategy, we must determine how our future forests will look. What types of 'end products' are we trying to produce from today's activities and investments?

Clearly any strategic goal for fibre production must be:

- an integral part of timber supply area plans and tree farm licence management and working plans; and,
- included in the planning process.

4.0 Forest-estate goals

How does one know if the forest management practices being employed for a forest estate are "correct"? Will these practices meet the target forest's goals? Are there well-defined management goals for each forest estate?

- What is the desired volume of fibre required in the future from each forest estate? What quality characteristics will this volume have?
- What is the harvest schedule that will be required in the future?
- What are the effects of our silvicultural management activities at the stand level? What impact will these activities have on other resources?
- What impact, at the forest level, will these individual stand level responses have on: quantity; quality; harvest schedule; and, geographic location?
- What is the age class distribution and what is the strategy to "normalize" the forest estate?

To date, our silviculture program has been primarily concerned with forest regeneration activities. Most of our efforts have been on silviculture planning and the setting of management goals to reach free-growing objectives. In many cases, we have not looked beyond the free-growing stage.

During this decade, our management efforts will shift to our second-growth forests.

5.0 Funding

The funding available for silviculture activities will, most likely, be less than the maximum that could be spent, given prudent and responsible management.

A silvicultural management strategy must:

- direct the spending of the available dollars in an effective and efficient way;
- focus spending on meeting each forest estate's management goals; and,
- require forest managers to be accountable for the spending needed to meet their forest estate's goals.

This accountability will provide feedback to ensure that each forest estate's goals are realistic and attainable.

During the last decade, annual silvicultural expenditures in the province increased from about $90 million to more than $250 million. Are we investing this annual sum effectively and effciently to meet our forest management goals?

6.0 Productive land base

The current public debate on forest management practices will influence the future use and management of our forests. It is likely that the land base for timber production will continue to be reduced. The legitimate requirements of other resource uses will also constrain the amount of timber available from the remaining land base.

We can evaluate the impacts of these land-base reductions by having clear management goals for each forest estate. We can assess the potential for offsetting the loss in fibre production through more intensive silviculture activities. Biologically, there are limits. In developing our strategy, we must recognize the multiple resources values inherent in our public forests. We must allow for a diversity of uses.

7.0 Technical principles

We need to understand some basic technical principles in order to structure logical and attainable forest management goals:

7.1 Biological response

We must understand the likely biological response to a specific silvicultural treatment on a particular stand and site.

Each stand has an infinite number of yield opportunities. They depend on stand density and distribution, site index, age, species composition. We must consider them all when we decide which opportunity is correct. Too often we consider silvicultural activities, such as site preparation, planting, brush control, spacing and fertilization, as stand-alone goals of their own.

Our management systems must consider silvicultural activities at the stand level.

We derive the long-run, sustained yields and the allowable annual cuts from the impacts of silvicultural management systems, not individual treatments.

It is inadequate and inaccurate to measure silviculture's financial impacts without looking at it as a collection of activities.

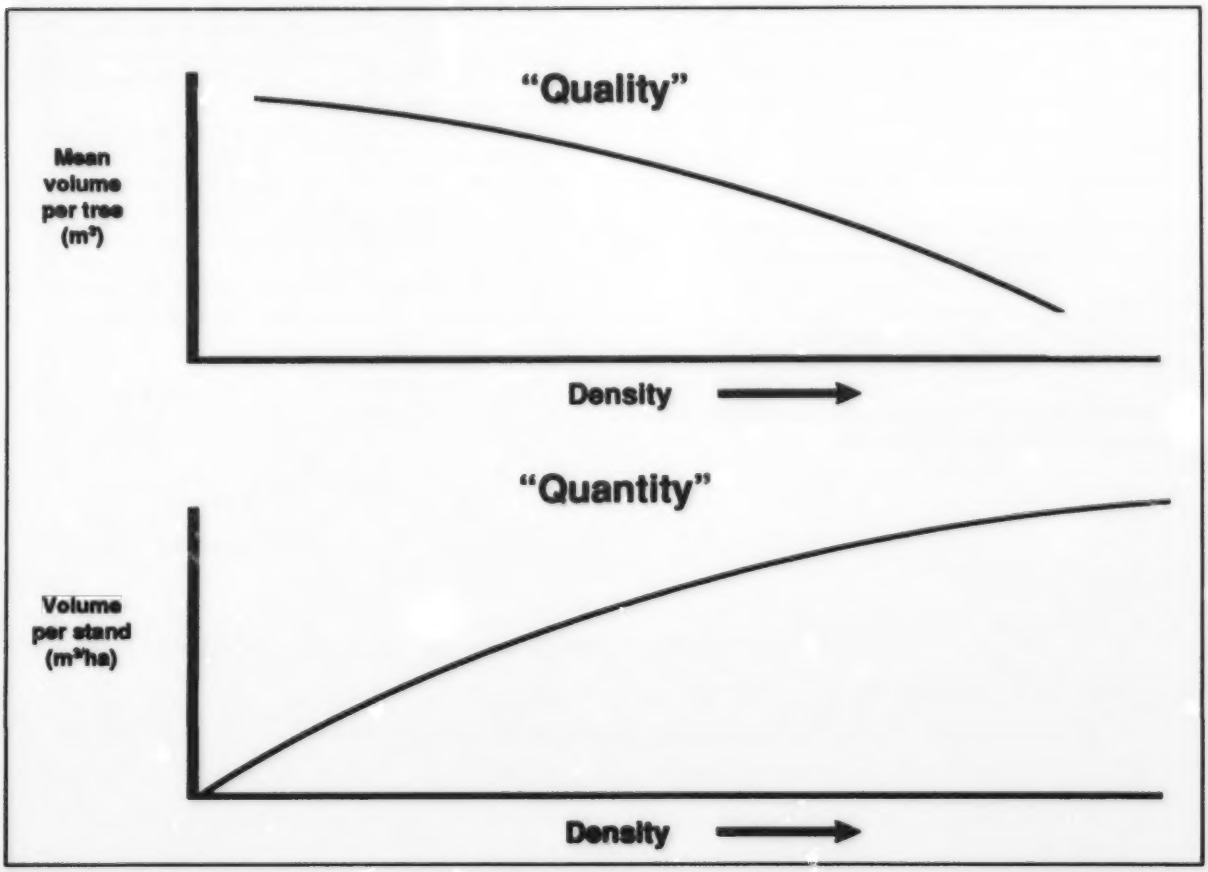
Because there are, for any given forest estate, dramatically different yields from the same management system when applied to different growing sites, we must know:

- what the yields of different initial densities will be, by species or species mix, on a site-by-site basis;
- what the yield impacts of different distributions of these stems across the growing site will be; and,
- the abilities of the site and the existing stand to respond to silvicultural treatments.

In summary, these important technical principles of stand growth-and-yield must be considered before forest management goals are established.

The effect of stand density on mean tree volume and total stand volume, is illustrated in Figure 2.

Figure 2: The balance between individual tree growth and stand growth



7.2 Financial Impacts

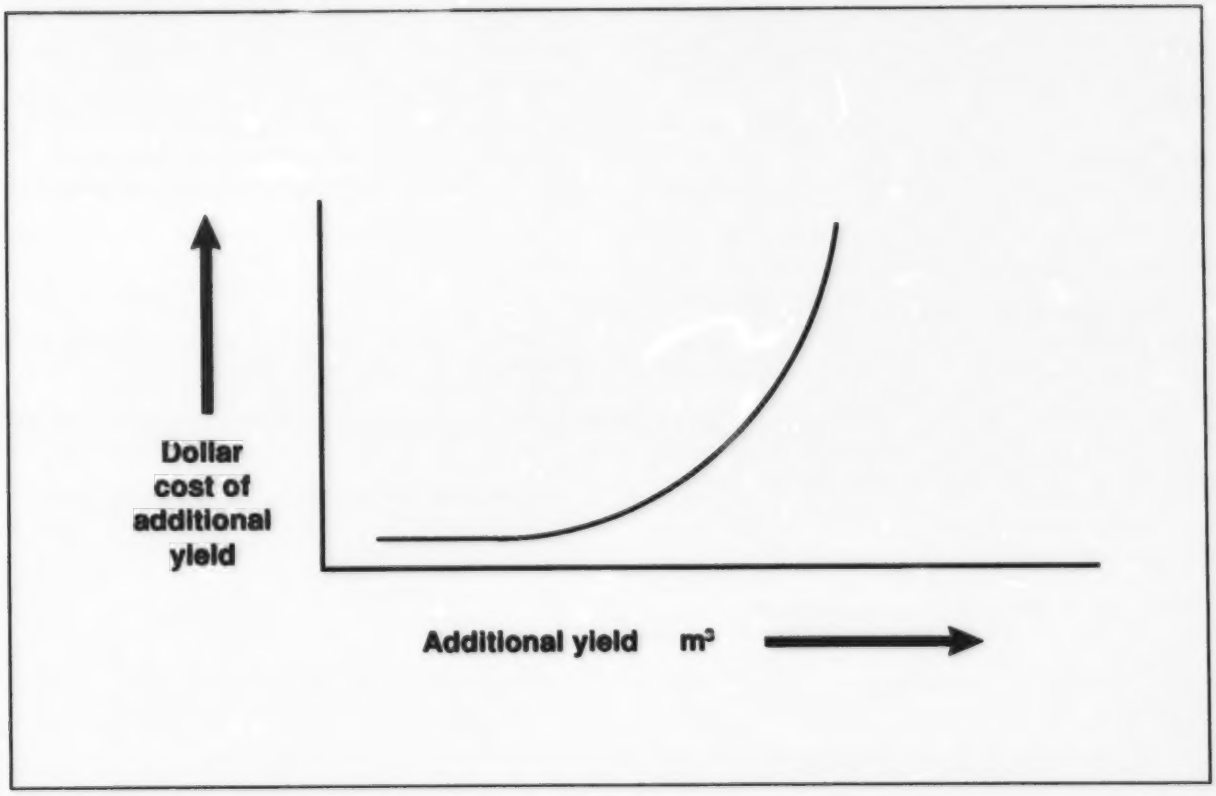
We must understand a treatment's financial results.

- What are the financial outcomes of the biological results of the various silvicultural managment systems we can apply to a stand?
- How do we use these financial decision-aids to set priorities for our activities and budgets?

In summary, the important technical principles of financial return must be considered before forest management goals are established.

The cost of obtaining additional yield from a stand is illustrated in Figure 3.

Figure 3: Relationship of yield increment to dollars of management effort required to obtain that increment



7.3 Forest Impacts

We must understand the impacts of an individual silvicultural treatment, a system of treatments on a stand, and the cumulative effects of treatments and systems on a number of stands in that forest estate. The optimum requirements to attain a target forest goal, when viewed at the individual stand level, may not be the optimum when viewed at a forest level.

7.4 Social Impacts

We must understand the economic impacts at local, regional, and provincial levels of the treatment activity benefits and the treatment result benefits.

We must consider these factors, outside of silviculture management, before developing forest estate goals:

- definitions of forest users and their needs;
- economic implications of employment;
- community stability;
- contribution to the Gross Domestic Product and others; and,
- opportunities for expanding markets for the products we can produce from the forest.

8.0 Analytical tools

Each timber supply area committee or tree farm licencee will select a technical process to develop the strategy and goals for each management unit. Some may adopt a simple approach. Others may opt for a more technical, analytical approach. Each committee or licencee will select the management tools and decision support aids to be used in developing their goals.

Ultimately, the goals will be determined and refined through a combination of stand modelling and forest estate modelling. The use of each is explained below.

8.1 Stand modelling

What will be the biological results of various silviculture management activities and systems on different sites and different species compositions? Unfortunately, there is not much empirical data available on managed stands. Therefore, we must rely on stand-level, growth-simulation models as decision-support aids for answers.

The development of sound silvicultural strategies requires the use of stand-level simulation models to come up with various stand level options. These same stand-simulation models need to be used in developing operational plans to priorize stand-level biological and financial opportunities.

The model to be used will depend on the how the results will be applied. The user should be comfortable with the results the model produces and the application of the results. There are many sources of stand-growth estimates.

They include:

- TASS — Tree and Stand Simulator;
- SPS — Stand Projection System;
- DFSIM — Douglas-fir Simulator;
- Prognosis; and,
- Y-XENO.

Appendix I provides more information on where to obtain these models.

8.2 Forest estate modelling

Forest-estate models are used to:

- project harvest forecasts for a defined set of management assumptions;
- establish fibre supply targets; and,
- determine long-run, sustained yields and allowable annual cuts.

The impact of silviculture systems on long-run, sustained yield can be significant. The volume of long-run, sustained yield can be increased or decreased considerably on any forest estate depending on the silvicultural management applied.

The correct and timely use of silvicultural management can lessen the impact of age class imbalances. Indeed, silviculture management can significantly alter the structure of allowable annual cuts.

Long-run, sustained yield does not drive management activities, rather management activities drive long-run, sustained yield and the resulting allowable annual cut.

Once a long-run sustained yield has been selected, the management assumptions that went into that long-run sustained yield must be followed by operational reality, otherwise the long-run, sustained yield and the allowable annual cut determination are not valid.

There are two basic types of forest estate models: simulation models and optimization models. Some of the models that can be used in B.C. are:

Simulation Models

- FIBRPLAN
- TRIM
- IFSYIELD
- PLANTS
- FEPA

Optimization Models

- MUSYC
- FORPLAN

Appendix II gives more information on these models.

9.0 Response

A response to this discussion paper is welcomed from all interested parties. Input from timber supply area committees and tree farm licence holders is particularly important.

Each timber supply area committee and tree farm licence holder should:

1. Identify the "challenge" for your forest estate, by listing the significant silvicultural opportunities and challenges.
2. Discuss and prepare a response to the attached questionnaire.
3. Prepare an action plan to develop a silvicultural strategy and goals for your forest estate.

Your comments, thoughts, and suggestions on the discussion paper are invited.

We have provided a questionnaire to aid you in your responses.

Please do not limit your responses to answering the questionnaire. We would particularly like to hear what approach each timber supply area committee and tree farm licence holder wishes to take.

Please submit your response by November 30, 1990, to the Director, Silviculture Branch, B.C. Forest Service, 31 Bastion Square, Victoria, B.C. V8W 3E7.

Towards a Silviculture Strategy

Questionnaire

Q 1. Do you have a strategic silviculture plan for your forest estate?

Q 2. Do you have natural and managed stand data for your forest estate? What additional information is required?

Q 3 What are the "target forests" for your forest estate?

- products
- average dbh
- average volume /ha.
- average piece size
- maximum MAI

Q 4. What is the age class distribution for your forest estate? How do you plan to normalize your forest age class structure?

Q 5. What is your maximum MAI goal for your area? (The intent is to add goals together to set a provincial goal.)

Q 6. Can you achieve the strategic goal of doubling the maximum MAI on your forest estate by the year 2020?

Q 7. What are the main silviculture activities with which you plan to meet your goals?

Q 8. What problems or obstacles do you see in reaching your goal?

Q 9. Does your strategy focus on maintaining, reducing, or increasing the harvest schedule?

Q 10. How do you incorporate non-timber resources into your silviculture strategies?

Appendix I

Computerized stand models

The following is a partial list of computerized stand models that can be used to estimate yields from stands in B.C.

1. Model Name: DFSIM

   Contact: Mensurationist, U.S.F.S., Forest Sciences Laboratory, 3625 - 93rd Avenue S.W., Olympia WA 98502

   Description: Estimates yield from pure Douglas-fir stands in the southern coastal area under a variety of common silvicultural treatments (planting, spacing, fertilization, and thinning).

2. Model Name: Prognosis

   Contact: Mensurationist, U.S.F.S., Forest Sciences Laboratory, 1221 S. Main, Moscow, ID 83843
   Manager, Growth and Yield Inventory Branch, Ministry of Forests, 1319 Government Street, Victoria B.C. V8W 3E7

   Description: Estimates yield from pure and mixed species stands (11 species) in the southern interior area under a variety of disease conditions and silvicultural treatments (planting, spacing, fertilization and thinning).

3. Model Name SPS

   Contact: Manager, Fortrends Consulting Inc., 1006 Government Street, Victoria, B.C. V8W 1X7

   Description: Estimates yield from pure and mixed species stands in coastal and interior regions under a variety of silvicultural treatments (planting, spacing, fertilization and thinning).

4. Model Name: TASS

   Contact: Manager, Forest Productivity and Decision Support, Research Branch, Ministry of Forests, 31 Bastion Square, Victoria, B.C. V8W 3E7

   Description: Estimates yield from pure species stands (coastal Douglas-fir, coastal western hemlock, interior lodgepole pine and interior spruce) under a variety of silvicultural treatments (planting, spacing, fertilization and thinning).

5. Model Name: Y-XENO

   Contact: MacMillan Bloedel Ltd., Woodlands Services, 65 Front Street, Nanaimo, B.C. V9R 5H3

   Description: Estimates yield from coastal Douglas-fir and western hemlock stands under a variety of common silvicultural treatments (planting, spacing, fertilization and thinning).

Appendix II

Computerized forest-estate models

The following is a partial list of computerized forest estate models that are available for use in B.C.

Optimization models:

1. Model name: MUSYC

   Contact: Ministry of Forests, Integrated Resources Branch, 1450 Government Street, Victoria, B.C., V8W 3E7

   Comments: Uncompiled FORTRAN code. Available at no charge. VAX based. Requires purchase on an LP model.

2. Model name: FORPLAN

   Contact: National Planning and Implementation Team, U.S. Dept. of Agriculture, Forest Service, Fort Collins, CO 84401

   Comments: Available at no charge. VAX based. Requires purchase of an LP model.

Simulation models

1. Model name: FIBRPLAN

   Contact: Fortrends Consulting Inc., 1006 Government Street, Victoria, B.C. V8W 1X7

   Comments: Commercially available. PC based.

2. Model name: TRIM

   Contact: College of Forestry, Oregon State University, Peavy Hall 140, Corvallis, Oregon 97331-5710

   Comments: Commercially available. VAX based.

3. Model name: IFSYIELD

   Contact: Planning Section, Industrial Forestry Service Ltd., Forest Industries Building, 1595 - 5th Avenue, Prince George, B.C. V2L 3L9

   Comments: Proprietary model.

4. Model name: PLANTS (modified FORMAN)

   Contact: Ministry of Forests, Integrated Resources Branch, 1450 Government Street, Victoria, B.C., V8W 3E7

   Comments: PC based.

5. Model name: FEPA

   Contact: Ministry of Forests, Integrated Resources Branch, 1450 Government Street, Victoria, B.C., V8W 3E7

   Comments: Proprietary model.

Glossary

- *Allowable annual cut (AAC)*: the annual rate of harvest from a 'forest estate' (see definition below); it is based on:
  - current harvestable inventory; the selected, long-run, sustained yield of that estate; and, other considerations.
- *Forest estate*: the forest unit's total, forested, land base — traditionally either a timber supply area or a tree farm licence.
- *Forest-estate model*: a computer model that allows the user to simulate harvest opportunities from differing forest-level management strategies.
- *Forest level*: pertains to the whole forest. The term is used when analyzing activities affecting a collection of stands that are administered as an integrated unit.
- *Long-run, sustained yield (LRSY)*: the harvest from a forest estate that can be perpetuated forever under a given management system.
- *Mean annual increment*: stand volume divided by stand age. Culmination age is when the mean annual increment reaches its maximum value.
- *Stand level*: pertains to individual forest stands. The term is used when analyzing activities affecting an adjacent group of trees that are sufficiently uniform in species composition, age class, and condition to be a homogeneous and distinguishable unit.
- *Stand simulation model*: a computer model that allows the user the opportunity to simulate the yield under various management strategies at the stand level. Different types of stand models are best suited to different applications.
- *Target forest*: the end-product forest that will result from today's silvicultural activities.